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THE NEW ENGLAND BOTANICAL CLUB

Vol. 44. May, 1942. No. 521.

SUBSPECIES AND VARIETY

F. Raymond Fosberg

In a recent discussion (Rhodora **43:** 157–167. 1941) R. T. Clausen presents a point of view on subspecies and varieties fairly widely held among American botanists, though not much subscribed to elsewhere. Fernald has previously presented an opposite point of view (Rhodora **42:** 239–246. 1940).

Clausen invokes a lengthy historical argument, the previous confusion in the use of 'variety,' and the necessity of cooperation with zoology to justify the use of 'subspecies' for "the most important variations under the species", restricting the use of 'variety' to "mere trivial genetic variations" "as the horticulturists do." The supporters of the now defunct American Code of Botanical Nomenclature and H. M. Hall and his followers have previously used the same arguments to arrive at the same conclusions. In Hall's own reasoning there was, however, a subtle difference, which will be brought out later.

Fernald advocates the use of the term subspecies for "a subdivision of an aggregate species, *Gesamtart* or *species collectivus*," and the term *varietas* for geographic variations of ordinary species, with variations which have no separate geographic ranges to be designated as *formae*. How he distinguishes between aggregate and other species is not too clear, except that he says that many botanists, including himself, regard the subspecies within them as deserving the rank of species.

That Fernald's view is at least nearer the correct one, nomenclaturally, may be seen by examining the system of categories set up in the present International Rules. Three, or, if desired, even more categories beneath the species are provided. The lowest of these three is *forma.* Clausen suggests no provision for more than two categories, and of these the most trivial is 'variety' or '*varietas.*' One is led to wonder what he would suggest as a term for the subdivisions of aggregate species. Clausen makes no mention of aggregate species, though, so perhaps we may assume that his concept of species and that of Fernald (excluding collective species) are essentially similar and that his 'subspecies' is synonymous with Fernald's '*varietas*' and his 'variety' is synonymous with Fernald's '*forma.*' This is, however, hard to reconcile with his statement on p. 166, "On the other hand, some of the species of the older botanists are only subspecies, since large series today demonstrate intergradation." What a slaughter this point of view would create among the species of *Rubus, Aster, Pinus, Quercus* and other genera where the specific lines are notoriously indistinct! Also, what of those otherwise perfectly distinct species which form hybrid swarms where they meet?

Clausen mentions H. M. Hall as favoring the use of the term 'subspecies' for the primary divisions of species as though this were in support of his own argument. Actually Hall's usage better supports Fernald's concept of subspecies as subdivisions of aggregate species. Certainly most of Hall's subspecies are or have been regarded as species by some other botanists, and many of his species would be admitted by any botanist to be 'aggregate species.' All of the lesser variations, including many so-called 'species' he threw into an unclassified category of "minor variations and synonyms."

The continued appeal to historical precedent may be interesting, but seems to me to have very little point in this connection on either side. Modern taxonomy is based on so much more information than was available to Linnaeus and the other older workers that their concepts can have but slight significance in the determination of the application of the present day nomenclatural equivalents of these concepts. Faced with the necessity for a simple method of expressing an infinitely complex situation, botanists have agreed upon a hierarchy of categories. To simplify the application of names, the designations of these categories were made to agree as far as possible with those used by the pre-evolutionary botanists. Any attempt to attach further significance than this to the historical background merely adds to the lamentable state of confusion which bothers so many of the writers on this subject.

If previous confusion is of significance in determining present use of categories, then certainly 'family,' 'genus,' and 'species' should be the ones to be thrown out, as they have been the subject of more confusion than has ever surrounded any intraspecific category. And if cooperation with, or imitation of zoologists is to be a deciding factor, certainly one of the first necessities is to eliminate the multitude of generic homonyms in the combined system, and another is to induce one or the other group to bring the suffixes for its higher categories into conformity with those of the other. Of course, none of these changes would likely be seriously recommended by anyone.

The solution seems actually simple enough, if one recognizes that there are many types of evolutionary process in operation, producing many kinds of species, and that intraspecific units may be incipient species in various stages of development. These stages may be at least roughly indicated by the categories in which the groups are placed. Each taxonomist may take the system of categories set up in the International Rules and apply it to the groups of plants with which he is working in the way that, in his judgment, best expresses the relationships of the groups of individuals concerned. The Rules require only that the order of the categories be not disturbed, and that each plant be placed in a species, genus, family, order, class, division and kingdom. All other categories are to be used at the discretion of the worker. In this way the system will retain the flexibility that is absolutely essential to make it fit the wide variety of evolutionary situations to which it must apply. Discarding of any of the categories, whether from reasons of historical confusion or personal prejudice, impairs this flexibility.

Since the above was written my friend Joseph Ewan, in a recent discussion (Bull. Torr. Bot. Cl. **69**: 138–149. 1942), recommends "the use of the term subspecies to replace the more inexact and variously used term variety," and at the same time deplores the practice of making new combinations for names originally proposed in one of these categories when they are transferred to the other. Apparently to be consistent with this, in spite of his immediately previous statement that he remains "confident of the enduring value of the use of the term subspecies" and the implication that he will use it in place of variety, on p. 141 he uses *D. hanseni* var. *arcuatum* Greene, and on p. 143 *D. hanseni* var. *kernense* Davidson, but on p. 147, *D. patens* subsp. *montanum* (Munz) Ewan for an apparently coordinate subdivision. In the discussion, on p. 139, however, he says, "To obviate this persistent confusion, . . . it seems to me desirable to adopt the straight trinomial when referring to the rank below that of the species." On p. 140, in a footnote, he says, "It is the author's express intent to avoid *formal* establishment of any name for *typical* subspecies, i. e., '*D. hanseni hanseni* nomen nov.', but to indicate by such usage that the typical phase of the species is intended. Technically such trinomials should be credited to Greene; . . . " On page 141 he uses *D. hanseni hanseni,* referring to it as a subspecies. One could not wish for a better example of the way in which the "persistent confusion, which cannot but reflect discredit upon systematic botany" is compounded. It is perfectly obvious that a non-systematic botanist could not possibly follow what Mr. Ewan is talking about, and equally obvious that he has not studied very carefully Articles 12 and 13 of the International Rules for Botanical Nomenclature. Such ambiguity has run almost universally through the writings of those who have recommended the use of the term *subspecies* in place of *varietas,* and yet their principal argument is the confused and inexact application of the term variety. In the light of Articles 12 and 13 it is perfectly plain that a transfer from one to the other of these categories must be accompanied by a change in authority and that the straight trinomial is completely meaningless. In the light of plain common sense it is obvious that if a name is used in print, i. e., *Delphinium hanseni hanseni,* it is published, and that Greene cannot be the author of the trinomial. Its author is Ewan. Greene was dead long before this trinomial was thought of.

It might be added that, in spite of Ewan's statement on page 139, lines 16–19, the practice of repeating the specific epithet for the designation of the typical subspecific unit has been followed in America by Dr. Rogers McVaugh (Mem. Torr. Bot.

Cl. **19** (4): 23, 27, 51. 1941; Am. Midl. Nat. **24:** 687, 695, 697, 1940; Ann. Mo. Bot. Gard. **27:** 347–349. 1940) and by myself in a number of as yet unpublished papers and in at least two published ones (Am. Midl. Nat. **26:** 69. 1941; Lloydia **4:** 275. 1941). Dr. Gleason has told me that he has definitely published the proposal, for action at the next Botanical Congress, that this method be made mandatory. The last example by McVaugh, cited above, is also an excellent example of a place where the use of both categories, *subspecies* and *varietas*, is desirable within the same species.

Finally, concerning the confusion surrounding the term 'variety,' most of those who dwell upon this confusion seem to overlook the fact that the confusion is about the term 'variety' while the category in the Rules is '*varietas*.' Botanically there has been relatively little confusion of the meaning of the Latin term. If one is worried by the confusion surrounding the English translation of this word, he should look up the English translations of the words '*genus*' and '*species*' in a good Latin-English dictionary (i. e. Cassell's) and see what confusion emerges. All three terms were good Latin words long before they were adopted by botanists, and had their popular meanings and attendant confusions. It seems to serve no good purpose to disturb legitimate botanical usage by recourse to arguments based on popular, horticultural, or even past botanical confusion.

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SUBSPECIES

C. A. Weatherby

Dr. Fosberg hardly needs support; yet the following rather desultory remarks, to be regarded as in the nature of footnotes, may perhaps usefully supplement his excellent discussion.

He is, of course, right in maintaining that present usage is of more importance than past; yet something may be learned from history, if only that arguments drawn from it may be worthless. In looking over the three preceding articles, I have been struck by the fact that Clausen places his chief emphasis on definitions, Fernald and Fosberg on practice. From the latter standpoint, the use of the term variety presents a natural and normal development. Linnaeus and his immediate successors used it for any and all groups subordinate to the species. As European floras were intensively studied, it was recognized that there were different grades of variants within species and a series of categories was accordingly worked out in the effort accurately to represent the observed facts of nature. In the "Lois" of 1867 de Candolle enumerated six such categories[1] and by 1905 this system had so far proceeded that there was included in the International Rules a provision designating variety and form as the terms primarily to be used for categories below the species, with a number of others, including subspecies, to be inserted, if desired, above, below and between them, and allowing authors full liberty to interpolate new categories as needed. This section (11) remains unchanged in the present rules[2]. In America, with larger areas to cover and much less detailed knowledge of their floras, a simpler system has for the most part been followed; but as early as 1856, in the second edition of his Manual, Dr. Gray was distinguishing major and minor varieties[3]. In both continents, as accumulating material in herbaria came to show ranges with reasonable reliability, geography, as a convenient test of the probable validity of varieties, came more and more into use. From the point of view of practice, all this development, though of course not even and symmetrical, has proceeded hand in hand with the increase of knowledge. The division of the Linnaean variety into several categories is roughly analogous to the division of aggregate Linnaean genera and species, and the addition of the geographic idea to the concept of variety comparable to the redescription of the older groups by the addition of newly discovered characters.

To Clausen, looking mainly at definitions, differences and developments in practice appear only laxity in the use of terms, and the introduction of the geographic test for varieties a violent departure from precedent. The trouble with this view is that, in so plastic and multiform an assemblage as the vegetable kingdom, precise and comprehensive definition of taxonomic categories is, in the absence of precise and comprehensive knowledge, a difficult and even dangerous business. Professor L. H. Bailey shows the wisdom of long experience when he remarks: "I define a variety as a lesser category of a species: other definitions do not hold water, being too philosophical or too subjective."[1] Linnaeus, inaugurating a system, no doubt felt obliged to offer some sort of explanation of his categories. He drew up a definition of variety based on certain observations of Ray (and presumably of his own) on garden plants, in which inconstancy was the important feature—and was at once compelled to force under it many groups of whose constancy or inconstancy he knew nothing[2]. Rather unfortunately, various more modern taxonomists (including, in a very modest way, myself) have also felt impelled to make definitions. I think it safe to say that, because of inadequate knowledge for generalization, not one, from Linnaeus to du Rietz, has been able to produce one which either he or anyone else could apply, over any wide field, with consistency or satisfactory results. This condition Clausen hopes to see corrected by the use of data provided by that immensely promising line of research, experimental taxonomy; but almost in the same breath he is forced to admit that it cannot now be done. "The biologically most important unit under the species is the ecotype, which can be determined only by experiment . . . Taxonomists, by the usual observational methods, can often detect geographic and ecologic variations which are the counterpart of the ecotype. Such variations are the taxonomic subspecies." "When the experimental part of the work has not been done, the . . . designation subspecies should be used alone." Clausen, then, is in the same position as was Linnaeus. Starting with a relatively insignificant body of experimental data, he has to deal with a vast number of plants in regard to which he has no comparable information; and he can find no better method than the ordinary exercise of taxonomic judgment, as practiced by Linnaeus and every other systematist, past and present. Of course, we can and do, with the knowledge accumulated since his time, turn out a greatly better job than Linnaeus could; but until that knowledge is complete, so long, that is, as we have to use judgment at all, the accuracy and soundness of the application of any taxonomic category, definition or no definition, will be in direct proportion to the accuracy and soundness of judgment of the individuals who apply it. This situation is not affected by any shifting of terms. This, of course, is not to say that the exercise of taxonomic judgment has not produced and will not produce very excellent results. The point is that Clausen has nothing new to offer to justify a revision of terminology—still less, a disruption of it.

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[1] See Weddell's translation, with comment by Asa Gray, in Am. Journ. Sci. ser. 2, xlvi. 63–77 (1868).

[2] As Fosberg points out, this is a flexible system, accommodating readily both authors who use only a single category and Ascherson & Graebner with their ten.

[3] His method of distinguishing them, by paragraphing and typography, was not altogether a happy one, since it was obvious to the eye alone and allowed the use of the same spoken term for both. It was, of course, to correct this that the term forma came into use for essentially his lesser varieties.

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[1] Gent. Herb. v. 18 (1941).

[2] Dr. Clausen's account of the Linnaean varieties would perhaps have been more adequate had he taken the unnamed ones into consideration. So far as I can see, they are quite as important as the named in indicating Linnaeus's ideas; some of them, like *Eupatorium purpureum* β, he later raised to specific rank. There is no obvious reason why he gave names to some and not to others.

It may be worth while to examine in how far the contention that subspecies is a more accurate term than variety is borne out by evidence, particularly as regards recent usage in the United States. "Subspecies" did not originate with Persoon; he did not use the term in any systematic way and seems to have been referring vaguely to some previous employment of it. What he had in mind was very likely Link's "Philosophiae Botanicae Novae Prodromus" (1798), in which (p. 187) subspecies are defined as strains "many of which are in cultivation and have become almost hereditary", which commonly come true from seed, but originally arose from the progeny of a single individual. Varieties, in Link's view, did not come true. Sprengel (Anleit. i. 372–3 (1817)) makes practical application of these ideas, designating as subspecies, on a strict basis of experimental taxonomy, cauliflower and Savoy cabbage[1]. De Candolle's "Lois" of 1867 still used subspecies for the most striking modifications of cultivated species. All this is more curious than important; but it is not without interest to observe that subspecies had as lowly a horticultural origin as variety; that from the beginning it was used in the sense aptly characterized by Dr. Gray as a "super-variety"[1]; and that it has ascended the taxonomic scale *pari passu* with variety and inseparable from it.

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[1] Anyone further curious about the history of subspecies may consult Dampier, Voyage, iii. 75 (1699), "there are . . . four sorts of these longleg'd Fowls . . . as so many Sub-Species of the same kind; viz. Crab Catchers, Clocking-Hens . . . ": Aikin, Dict. Chem. & Min. ii. 13 (1807), "Arseniat of Lead; of this there are two subspecies": Encycl. Britannica, ed. 9. xii. 19, "verse narrative . . . is . . . a subspecies by itself." Followers of Hall may take what comfort they can from the fact that Link also refused to give names to varieties.

The followers of the American Code, in practice, applied subspecies indiscriminately to anything below the rank of species[2]. The work of Hall and his collaborators was, in part, a protest against the excessive splitting of Greene and his followers. In consequence, his subspecies were of very high morphological content and took no account of geography; they are the equivalent of the extreme of European usage—minor species, grouped under collective species and called subspecies. This fact, however, was obscured by Hall's failure to give any place to lesser variants which he recognized and described but would not name, partly because of uncertainty as to their nature and partly because of a prejudice against the term variety. The result is a rather curious mixture of the form of the American Code and the substance of Aschersonian systematics.

Pennell, using the three categories, subspecies, variety and form, unreservedly accepts du Rietz's purely geographic system. The result is a great lowering of the morphological content of the subspecies, as compared to that of Hall, and the almost complete disappearance of any morphological distinction between subspecies and variety. "*Lindernia dubia major* var. *inundata*", for instance, characterized by shape of leaf, length of pedicel and habit, is a variety because it occurs at more or less scattered stations within the range of the species. "*Pagesia acuminata microphylla*", distinguished by precisely the same sort and degree of variation in shape of leaf, length of pedicel and habit, is a subspecies because it is found in a single region in Alabama on the southern edge of the range of the species.[3]

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[1] [Varietas] "nonnisi gradu a subspecie differt". Link. For most of these references I am indebted to Prof. A. S. Pease and Dr. H. K. Svenson.

[2] The use of subspecies in the American Code appears to have been an afterthought, due probably to ornithological influence. In the earlier versions of and discussions about the Code, variety was used; only in the final revision, published in 1904, was it "relegated to horticultural usage."

[3] It is interesting to observe that Pennell, equipped with unusually ample geographic knowledge of his group, and freely recognizing subspecies and formae, could find in eastern North America only four populations which answered to du Rietz's definition of variety, and that all four of these are estuarine. Their "local" distribution is therefore due to preference for a highly specialized habitat and is an essentially ecological, not geographic, phenomenon. Had the Atlantic coast of the United States been arranged like the Pacific, with a single large river at the north and no

Clausen, in his one major attempt to put his system into practice, keeps the exclusively geographic criterion for subspecies, but denies it to varieties, degrading that category to the level of the forma (a term which he does not use) of du Rietz, Fernald and Pennell. One might expect that this would produce a definite gap between subspecies and variety; on the contrary, any morphological difference between them again almost completely disappears. *Botrychium multifidum* ssp. *typicum*, "of medium or small size . . . the ultimate divisions usually rather crowded and sometimes overlapping", and ssp. *silaifolium*, "rather large . . . the ultimate divisions rather remote and not imbricate", are treated as subspecies. *B. Schaffneri* var. *typicum*, "lax and large", and var. *pusillum*, "stout, compact and small", appear as varieties. And at least some of the varieties of *Ophioglossum nudicaule* have a far stronger morphological basis than the first two subspecies of *O. lusitanicum*.[1]

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estuaries elsewhere, the *Lindernia* could have occurred only at the northern edge of the range of the species and would automatically have become a subspecies. Should the *Pagesia* be discovered at an isolated station or two in the Carolinas (as a good many species have been found in the white-sand areas of Wilmington, North Carolina, and southeastern Virginia and not between), it would, equally automatically, become a variety. Nothing could better illustrate the limitations of a purely geographic criterion of infraspecific categories and, unless one denies all importance to morphological characters, the artificiality of the system which may result from its use. Geography is not a character; it is rather a reagent. Since isolation tends to preserve genetic lines, it is, in the absence of experiment, a handy test of the probable permanence of variants; it can be nothing more. (Du Rietz, Fundamental Units of Biological Taxonomy, in Svensk Bot. Tidskr. xxiv (1930), especially pp. 348–357; Pennell, Scrophulariaceae of eastern temperate North America, Acad. Nat. Sci. Philadelphia, Mon. i (1935)).

[1] Clausen, Monograph of Ophioglossaceae. Mem. Torrey Bot. Club, xix (1938).

Not only are the characters of ssp. *silaifolium* the same as those of varieties in other species; they are exactly the sort of modification one would expect to appear in the milder climate and more favorable growing conditions of the more southern area which it inhabits. It is true that experiment in California has shown that some large and small forms of the same species occurring at different altitudes remain unchanged when transplanted to other environments. Nevertheless, this and such cases as *Asplenium platyneuron* var. *bacculum-rubrum*, *Dryopteris fragrans* var. *remotiuscula*, and *Botrychium virginianum* var. *intermedium*, offer inviting subjects for experimental testing. I hope someone can apply it to them.

I am, of course, aware that the same character may have very different degrees of taxonomic importance in different groups. But in the instances cited from Pennell and Clausen, there is no evidence that they perceived anything of the sort or paid attention to any but purely geographic considerations. In any case, I am only applying, from the morphological point of view, the same test which Clausen applies, from the geographic, to the varieties of Gray's Manual. I hope I have done it more carefully and candidly than the anonymous colleague who "analyzed" 105 "unselected" varieties of the Manual without ever noticing whether they were major or minor varieties. Had he confined himself to the criticism that some varieties were geographic and some not, no exception could have been taken to his procedure; but

Irmscher, attempting to apply du Rietz's system to Chinese Begonias, arrived at results like those of Pennell and Clausen, but, unlike those authors, was far from pleased with them. Groups, he says, which he could only regard as of equal phylogenetic rank became, according to their ranges, partly subspecies, partly varieties. Even du Rietz's test for species, discontinuity of biotypes, broke down in this group when tried out from the morphological angle. Irmscher became so disgusted with the "gemischtrangige Sippenreihe" which emerged from the du Rietz system that he threw it overboard altogether, substituting a primarily morphological one of his own and in the process discarding the term subspecies as (of all things) *too confused*, and putting a new term, turma, in its place.[1]

Finally, there is a contemporary instance of the classical use of subspecies which deserves brief attention because of its exceptionally clear-cut character. Tryon has recently published a revision of the genus *Pteridium*.[2] His point of view is conservative; it would have had the approval of Prof. Hall. He reverts to the old concept of *Pt. aquilinum* as a polymorphic cosmopolitan species. He finds, however, that it breaks up into twelve varieties, distinguished by relatively minor characters, all geographic and all intergrading where their ranges touch. These varieties in turn fall into two larger groups, also geographic and also not sharply disjunct, but connected, morphologically and seemingly genetically, by var. *yarrabense* (southeastern Asia to northern Australia), which produces intermediates with both (though their extremes do not cross where they meet in the American tropics) and cannot be dismissed as a hybrid swarm since it is reasonably uniform over a wide area where no possible parent exists. Under the system of du Rietz, Pennell and Clausen, Tryon would have had to call his lesser groups subspecies;[3] yet he could not have called the larger ones species because they lack the required discontinuity. On the other

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when he complains that some are mere modifications and others equivalent to subspecies and fails to mention that an attempt (however unsuccessful he may consider it) to grade varieties on just this basis was made, he is not playing fair.

[1] Irmscher in Mitth. Inst. Bot. Hamburg, x. 459 (1939).

[2] In RHODORA xliii. 1–31, 37–67 (1941) (Contrib. Gray Herb. 134). Tryon's work was done as a candidate for the doctor's degree under my general supervision; but his taxonomy is wholly his own.

[3] Hultén, Fl. Alaska in Lunds Univ. Arsskr. N. F. Avd. 2, xxxvii. no. 1, 44 (1941), has done so.

hand, had he followed Hall's practice, or any other using only one category below the species, he would either have had no place for his lesser, geographically distinct, groups, or would have had to put them in a single series with no indication of their relative affinities. It is sometimes difficult to distinguish between the moving up and down of categories in the morphological scale attendant on splitting and lumping and a shifting which actually disrupts the taxonomic series and diminishes its responsiveness to the varied facts of nature. *Pteridium* and cases like it are good testing agents.[1]

From this rather casual survey, it appears that subspecies began as a term for minor horticultural strains and that all recent redefinitions of it are quite as reprehensible departures from the original as are those of variety; and that, in the fifty years since its comparatively peaceful and consistent development was disturbed by the American Code, it has acquired quite as many different uses (except the horticultural) as variety. It has been all-inclusive and highly specialized; of morphological content so high as to be equivalent to the Englerian subspecies and so low as scarcely to differ from the classical forma; it has been geographic and non-geographic, experimental and non-experimental; finally, it has achieved the ultimate ignominy of being cast into an outer darkness even blacker than that prepared for variety by the American Code. There is little here to support the contention that it has any inherent superior accuracy.

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[1] There are no doubt a considerable number of groups in the east-American flora in which, unless we are to disregard entirely number and kind of characters and adopt a wholly behavioristic classification—I use the adjective with apologies to the philosophers—degrees of relationship would be better shown by a three- or four-story system than by any simpler one. Three such groups with which I happen to be familiar are those of *Dryopteris spinulosa*, *Acalypha virginica* and *Eupatorium purpureum*. All are alike in that their members are obviously much more closely related to one another than to any other members of their genera and have been treated both as species and varieties by different authors in the past. In other respects, the groups are unlike. The three components of the first are geographically separated, but their ranges overlap considerably and where they do hybridization is fairly frequent. There are no very good varieties. In the second, there is no geographic and little ecological segregation, and also little crossing; two of its three members have readily recognizable geographic varieties. The third shows an intermediate condition; its four members are somewhat, but not sharply, separated geographically and ecologically, there is some apparent interbreeding and there are two regional, not very strong, varieties. All the members of all three are a bit weak as species, though they have usually been treated as such by recent authors; certainly they are not coördinate with other species of their genera. They cannot be fully accounted for by any purely geographic system, nor by any which depends at all rigidly on discontinuity; but the classical system of subspecies, variety and forma (there is some room for formae in them) puts their classification into very good order.

The zoological analogy has attracted others beside Dr. Clausen; but is it real? Is there any sound basis for uniformity of usage in vertebrate zoology and botany, or would it prove a forced and unnatural hybridization? The organisms with which the two disciplines deal are very different. It can hardly be without significance that in the best-known zoological groups the simplest series of categories has been developed, whereas the most elaborate series of botanical categories appears in the most intensively studied groups and floras. If there is to be correspondence, one would suppose that it would naturally be with that department of zoology which, in number of species and as yet imperfect knowledge of them, most nearly approximates the conditions in botany and which, moreover, in some of its families has the closest biological connection with plants—namely, entomology. Those who talk largely about uniformity between botany and zoology do not mean zoology as a whole; at most they mean vertebrate zoology and more often, I suspect, no more than ornithology.[1] They do not tell us that zoological usage is not uniform, that the rigidly geographic, single infraspecific category of the ornithologists does not everywhere obtain. In entomology, the botanical series of subspecies, variety and form (sometimes further elaborated) is being used in the classification of *Lepidoptera* and *Coleoptera;* in that of ants, subspecies and variety are regularly employed for different grades of variation within species. What their morphological level may be, I do not know; I am here on unfamiliar ground; but there seems no doubt that, confronted by similar conditions, the entomologists have developed a system more like the botanical than that is like the ornithological.[2]

In any case, if there is to be correspondence, why not have the vertebrate zoologists adopt the botanical way? They would gain a good deal.

As to horticultural usage, it is almost enough to say that the botanist who has had the longest and closest connection with it,

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[1] Of the zoologophilous botanists who have come to my notice, only Coville and Clausen have been definite enough to say this; even they are silent as to entomology.

[2] For chance examples of the contemporary use of variety and of three categories (but not the term forma) in entomology, see articles by Normand & Vidal in Bull. Soc. Hist. Nat. Afrique du Nord, xxx. (1938) and by Hustache in Bull. Mans. Soc. Linn. Lyon, x. 5 (1941). For information as to entomological usage I am indebted to Prof. C. T. Brues.

L. H. Bailey, goes on undisturbedly using variety in his botanical work. It may be added that the horticulturalists themselves are dealing vigorously and clear-headedly with the matter.[1]

What Dr. Clausen really asks is that we all accept the terminology employed by the experimental taxonomists now working in California. It is not unfair to say that this terminology is a sort of ecotypical habit, characteristic of a relatively small population isolated in the United States of America. Even so, it might be the coming thing and we might, with due adjustment of the rules, accept it if it had any organic connection with the greatly promising work its protagonists are doing—as, I hope, we shall accept the really organic term apomict for the asexual variants in ligulate *Compositae*.[2] But it has no such connection; it appears, rather, to be an uncritical carrying over of Hall's personal practice to concepts different from his and set against a different nomenclatural background.

The experimental approach has, so far, wrought no revolution in taxonomy. It has, in some cases, revealed an almost terrifying complexity of forces underlying the morphological expressions we know; it has discredited, finally we hope, ill-considered splitting; but in general, save in places where taxonomists have been uncertain, it has supported their conclusions.[3] It has shown that the characters of gross morphology which they, of necessity, have used, really are significant. All this is immensely valuable and, to old-fashioned taxonomists, heartening. We are familiar, under other names, with cenospecies which cannot cross with one another, with ecospecies which will hybridize weakly, with ecotypes which cross freely, given the physical opportunity, and produce series of intermediates; but hitherto there has been an element of conjecture about them. We are grateful that a foundation of experimentally tested fact is being built under them; we are ready to welcome any readjustments of the taxonomic structure which may be proved necessary; but we do not see that these things call for any revision of taxonomic terminology.

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[1] See, for instance, Stout in Amer. Journ. Bot. xxvii. 339–347 (1940) and the introduction to the new edition of Standardized Plant Names.

[2] Stebbins's system of treating these dead-end strains as minor units grouped around the species which they most resemble or from which they are known to have been derived seems preferable to Turesson's treatment of them as agamic species. See Stebbins & Babcock, American Species of Crepis in Carnegie Inst. Pub. 504 (1938).

[3] Cf. J. Clausen, Keck & Hiesey in Amer. Journ. Bot. xxvi. 104 (1939).

And we wish that the experimenters had looked into this phase of the matter far enough to perceive that clarity is not only not to be achieved by a shifting of terms, but is actually hindered thereby.

Insistence by the makers of the American Code on unessential details and disregard by them of majority usage, when a little yielding to it would not have harmed their major position, brought about thirty years of needless nomenclatural controversy. The most obvious result of a similar insistence on "subspecies" and a like disregard for the use of it by most botanists in the past has been the unedifying spectacle of one group of taxonomists busily transferring varieties to subspecies and another group equally busy making transfers in the opposite direction—a tempest in a teapot also quite needless. All difficulty not wholly illusory would have been avoided by the simple, and one would suppose the obvious, expedient of following the rules and using variety as the term primarily to be employed for subdivisions of species. If the workers in experimental taxonomy have convinced themselves that only one infraspecific category is worth while[1], so be it; if they can prove it, well and good; variety would still better serve their turn and would meet with no opposition.

Gray Herbarium.

THIRD LIST OF FUNGI OF NANTUCKET[2]

E. F. Guba and E. V. Seeler, Jr.

Sufficient further collections have been studied to make possible a third list of fungi of Nantucket. Several specimens collected in previous years still remain to be determined and much further work is required before the record of the fungous flora of the island can be considered fairly complete.

Certain numbers of fleshy fungi appearing in this list and indicated by an asterisk are taken from a list of names submitted to the Nantucket Maria Mitchell Association in 1939 by Dr. Jacob E. Lange, Director, Fyns. Husmandsskole, Odense, Denmark. Dr. Lange's records are based on material which he collected on Nantucket in August 1927 and September 1939. Other collections and identifications mentioned in this and previous lists were made by Linder (Harvard University), Diehl and Cash (United States Department of Agriculture), Rice (Wheaton College), Gilgut (Massachusetts State College) and others. The writers are most grateful to them for their collaboration.

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[1] Americans, in line with previous practice in this continent, mostly use only one. So far as I have observed, Europeans, though they have lowered more or less the morphological content of the subspecies and, in consequence, use that term more frequently than in the past, still freely employ two or three categories.

[2] Contribution of the Nantucket Maria Mitchell Association, Div. of Natural Science, Nantucket, Mass. For the first and second lists see Rhodora **39**: 367–376, 1937, and **41**: 508–520, 1939. The cost of publication is met by the Maria Mitchell Association.

201. ALTERNARIA SONCHI J. J. Davis. On leaves of *Sonchus arvensis* L. Generally present. August, 1937. Coll. and det. by *E. F. Guba.*

202. AMANITA PHALLOIDES (Bull. ex Fr.) Fr. On ground near pines south of Fair Grounds, and in Saul's Hills. July 24, 1938. Coll. and det. by *E. V. Seeler, Jr.* Quite common, and most poisonous.

203. *AMANITOPSIS STRANGULATA (Fr.) Karst.

204. *AMANITOPSIS VAGINATA (Bull.) Karst.

205. AMANITOPSIS VAGINATA (Bull.) Karst. var. FULVA (Schaeff.) Sacc. Hidden Forest, July 27, 1940. Coll. and det. by *D. H. Linder.*

206. ARCYRIA CINEREA (Bull.) Pers. On decaying wood, Hidden Forest, August 5, 1938. Coll. and det. by *E. V. Seeler, Jr.*

207. ARCYRIA DENUDATA (L.) Wettstein. On decaying wood, Hidden Forest, August 5, 1939. Coll. and det. by *E. V. Seeler, Jr.*

208. ARCYRIA NUTANS (Bull.) Grev. Hidden Forest, July 27, 1940. Coll. by *D. H. Linder;* det. by D. P. Rogers.

209. ASCOCHYTA GRAMINICOLA Sacc. On leaves of *Andropogon scoparius* Michx. Manifest as small, dense punctiform pycnidia on the lower surface of the leaf-blades. Same as No. 106 except for host. August 20, 1937. Coll. and det. by *E. F. Guba.*

210. AURISCALPIUM VULGARE S. F. Gray. *Hydnum auriscalpium* L. ex. Fr. On fallen cones of *Pinus rigida* Mill. State Pines south of Fair Grounds. Sept. 5, 1939. Coll. and det. by *J. E. Lange.*

211. BELONIUM EUSTEGIAEFORME (B. & C.) Sacc. On *Spartina pectinata* Link. Long Pond near Madaket Rd. May 30, 1936. Coll. by *E. F. Guba;* det. by E. K. Cash.

212. BOLETUS VERSIPELLIS Fr. Growing in mat of *Arctostaphylos*, Saul's Hills, about ½ mile west of Altar Rock. October 11, 1940. Coll. by *E. V. Seeler, Jr.;* det. by Walter H. Snell.

213. CALODON **alboniger** (Peck) Seeler, n. comb. *Hydnum albonigrum* Peck. Rept. N. Y. State Mus. Nat. Hist. **50:** 110, 1897. *Phellodon alboniger* Banker. Mem. Torr. Bot. Club **12:** 167, 1906. In mat of needles of *Pinus rigida* Mill. State

Pines south of Fair Grounds, Aug. 7, 1938. Coll. and det. by *E. V. Seeler, Jr.*

214. Calodon velutinum (Fr.) Quélet. *Hydnum velutinum* Fr. In mat of needles of *Pinus rigida* Mill. State Pines south of Fair Grounds, Oct. 23, 1938. Coll. and det. by *E. V. Seeler, Jr.*

215. Cantharellus aurantiacus (Wulf. ex Fr.) Fr. In mat of needles of *Pinus strobus* L. State Pines south of Fair Grounds, Sept. 2, 1940. Coll. and det. by *E. V. Seeler, Jr.*

216. Cantharellus cibarius Fr. On ground, Hidden Forest, Aug. 5, 1938. Coll. by *K. S. Seeler;* det. by E. V. Seeler, Jr.

217. Cantharellus cinnabarinus Schw. On ground, Hidden Forest, July 31, 1938. Coll. by *E. V. Seeler, Jr.;* det. by D. H. Linder.

218. Ceratiomyxa fruticulosa (Muell.) Macbride. Hidden Forest, July 27, 1940. Coll. and det. by *D. H. Linder.*

219. Chrysomyxa cassandrae Tranzschel. *C. cassandrae* (P. & C.) Tranz. in Arthur. On *Chamaedaphne calyculata* (L.) Moench. Siasconset road swamp, Aug. 28, 1940. Coll. and det. by *M. A. Rice.*

220. Clavaria cristata (Holmsk.) Pers. In mat of pine needles. State Pines south of Fair Grounds, July 25, 1940. Coll. and det. by *D. H. Linder.*

221. *Collybia dryophila (Bull.) Fr.

222. Collybia lacerata (Lasch ex Fr.) Fr. On dead roots of *Pinus* sp. near soil surface. State Pines south of Fair Grounds, Aug. 11, 1940. Coll. by *K. S. Seeler;* det. by R. Singer.

223. *Cordyceps militaris Link.

224. Cortinarius torvus Fr. Hidden Forest, Aug. 5, 1938. Coll. and det. by *E. F. Seeler, Jr.*

225. Cryptoporus volvatus (Peck) Hubbard. *Polyporus volvatus* Peck. On trunk of dead tree of *Pinus rigida* Mill. State Pines south of Fair Grounds, July 25, 1940. Coll. by *E. V. Seeler, Jr.;* det. by D. H. Linder.

226. Cyphella villosa (Pers. ex Fr.) Karsten. On dead parts of beach grass, *Ammophila breviligulata* Fern. North Shore sand dunes just west of Nantucket Golf Course. Sept. 5, 1939. Coll. and det. by *E. V. Seeler, Jr.*

227. Daedalia unicolor Fr. On dead *Acer rubrum* L. Hidden Forest, May 29, 1939. Coll. by *E. V. Seeler, Jr.;* det. by D. H. Linder.

228. Diatrypella eutypoides Niessl. On dead branches of *Ulmus americana* L. Brant Point, Apr. 23, 1939. Coll. by *E. V. Seeler, Jr.;* det. by L. E. Wehmyer.

229. Dinemasporium gramineum Lév. On leaves of *Andropogon scoparius* Michx. Aug. 20, 1937. Coll. and det. by *E. F. Guba.*

230. Eccilia rhodocylix (Lasch ex Fr.) Fr. On ground under *Quercus velutina* Lam. State Pines south of Fair Grounds, Sept. 5, 1939. Coll. by *E. V. Seeler, Jr.;* det. by J. E. Lange.

231. Entoloma strictius Peck. On mat of pine needles, State Pines south of Fair Grounds, Sept. 2, 1939. Coll. by *E. V. Seeler, Jr.;* det. by J. E. Lange.

232. Entoloma lineatum (Cke.) J. J. Davis. On leaves of *Zizania aquatica* L. Coll. by *M. A. Rice;* det. by W. W. Diehl.

233. Eurotium herbariorum (Wigg.) Link. On pressed leaves and stems of *Rubus* with *Gymnoconia Peckiana* (Howe ex. Peck) Trotter. June 27, 1940. Coll. by *M. A. Rice;* det. by D. H. Linder.

234. Exidia glandulosa (Bull.) Fr. On fallen branch, Hidden Forest. July 27, 1940. Coll. and det. by *D. H. Linder.*

235. Flammula penetrans Fr. On stumps of *Pinus* sp., common in the fall. State Pines south of Fair Grounds, Sept. 5, 1939, and often since. Coll. by *E. V. Seeler, Jr.;* det. by J. E. Lange.

236. Fomes annosus (Fr.) Cooke. On stump of *Pinus rigida* Mill. State Pines south of Fair Grounds, Aug. 11, 1938. Coll. by *E. V. Seeler, Jr.;* det. by D. P. Rogers.

237. *Gabera hypnorum Fr.

238. Gloeosporium polygoni Dearn. & House. On living leaves of *Polygonum persicaria* L. with *Septoria polygonorum* Desm. In cultivated field along Hummock Rd. Aug. 17, 1936. Coll. and det. by *E. F. Guba.*

239. Helotium scutula (Pers. ex Fr.) Karsten. On fallen twig, swamp near Ram pasture. Coll. by *M. A. Rice;* det. by W. L. White.

240. Hymenochaeta corrugata (Fr.) Lév. On dead branch of *Acer rubrum* L. Hidden Forest (1) May 30, 1936. Coll. by *E. F. Guba;* det. by W. W. Diehl. (2) July 27, 1940. Coll. by *D. H. Linder;* det. by W. L. White and D. P. Rogers.

241. Hymenochaeta tabacina Sowerby ex Lév. On fallen branch, Hidden Forest, Oct. 11, 1940. Coll. by *E. V. Seeler, Jr.;* det. by D. P. Rogers.

242. *Hypholoma candolleanum Fr.

243. Hysterium pulicare Pers. On bark of *Cornus florida* L., Hidden Forest, May 30, 1936. Coll. by *E. F. Guba;* det. by E. K. Cash.

244. Hysterographium praelongum (Schw.) E. & E. On dead branch of *Ulmus americana* L. on living tree. Brant Point, Apr. 23, 1939. Coll. and det. by *E. V. Seeler, Jr.*

245. Hysterographium vulvatum (Schw.) Sacc. On twigs of *Sassafras variifolium* (Salisb.) Kuntze, Hidden Forest, May 31, 1936. Coll. by *E. F. Guba;* det. by E. K. Cash.

246. Kunkelia nitens (Schw.) Arth. III. On *Rubus* sp. Old Dump, Nantucket, July 3, 1940. Coll. and det. by *M. A. Rice*. Short cycle by germination. See No. 39 for long cycle.

247. Laccaria laccata (Scop. ex Fr.) Berk. & Br. Growing in mat of pine needles, State Pines south of Fair Grounds, Sept. 16, 1940. Coll. by *K. S. Seeler;* det. by E. V. Seeler, Jr.

248. Lactarius theiogalus (Bull. ex Fr.) Fr. In mat of pine needles; common. State Pines south of Fair Grounds, Sept. 5, 1939. Coll. by *E. V. Seeler, Jr.;* det. by J. E. Lange.

249. *Lepiota umbonata (Schum.) Lange.

250. *Lepiota lutea (Bolt.) Quél.

251. Lophodermium juniperinum (Fr.) de Not. (Immature). On leaves of *Juniperus virginiana* L. Siasconset Rd., May 30, 1936. Coll. by *E. F. Guba;* det. by E. K. Cash.

252. *Marasmius androsaceus (L.) Fr.

253. Melanconium typhae Pk. On dead stems of *Typha latifolia* L. Border of Long Pond near Madaket Rd. and along Miacomet Pond, May 30, 1936. Coll. by *E. F. Guba;* det. by J. A. Stevenson.

254. *Mutinus bovinus Morg.

255. *Mycena alcalina Fr.

256. Mycena sanguinolenta (Ars. ex Fr.) Fr. In mat of pine needles; common. A small delicate mushroom with red juice in the stem. State Pines south of Fair Grounds. Coll. by *E. V. Seeler, Jr.*, det. by J. E. Lange.

257. Nummularia microplaca (B. & C.) Cke. On dead branches of *Sassafras variifolium* (Salisb.) Kuntze, Hidden Forest, May 1936. Coll. by *E. F. Guba;* det. by W. W. Diehl.

258. Nyctalis asterophora Fr. This is a small sturdy mushroom which grows on top of the large funnel-shaped *Russula delica* Fr. so common and pushing up patches of the pine needle mat. State Pines south of Fair Grounds, July 25, 1940. Coll. by *D. H. Linder;* det. by E. V. Seeler, Jr.

259. Panus stipticus Fr. On bark of *Quercus* sp., Coskata Woods, August 7, 1940. Coll. and det. by *E. V. Seeler, Jr.*

260. Pezicula australis Rehm. On bark of dead *Gleditsia triacanthos* L., "Harp-O-the-Winds", Wauwinet Rd., June 25, 1938. Coll. by *E. V. Seeler, Jr.;* det. by J. Walton Groves. (This determination is tentative until the fungus can be grown in culture as this is a new host.)

261. Phaeobulgaria inquinans (P. ex Fr.) Seaver. *Bulgaria polymorpha* (Oeder ex Fr.) Wettstein. In logs of *Quercus* sp. shipped from Mattapoisett, Mass., Steamboat Wharf and Island Service Co. yard, Aug. 16, 1937. Coll. and det. by *E. V. Seeler, Jr.*

262. Phyllachora graminis (P. ex Fr.) Fckl. On stems and leaves of *Ammophila breviligulata* Fernald (see Nos. 160 and 161),

south end of Madaket Rd., May 30, 1936. Coll. and det. by *E. F. Guba.*

263. Phyllachora graminis (P. ex Fr.) Fckl. On *Andropogon virginicus* L. in field at Polpis, Sept. 29, 1936. Coll. and det. by *E. F. Guba.*

264. Phyllachora graminis (P. ex Fr.) Fckl. with *Puccinia peridermispora* (Ellis & Tr.) Arth. On *Spartina alterniflora* Loisel. var. *glabra* (Muhl.) Fern., Long Pond Shore near ocean, August, 1940. Coll. by *M. A. Rice;* det. by E. F. Guba.

265. Phyllachora trifolii (P. ex Fr.) Fckl. On living leaves of *Trifolium hybridum* L. Waste places, Siasconset, August 18, 1936. Coll. and det. by *E. F. Guba.*

266. Phyllostictina pallidior (Pk.) Petrak & Syd. On leaves of *Smilacina stellata* (L.) Desf., Coatue, Aug. 1940. Coll. by *M. A. Rice;* det. by E. F. Guba.

267. Phragmidium speciosum (Fr.) Cke. On living leaves of *Rosa virginiana* Mill. Madaket. June 25, 1936. Coll. by *G. Wyatt;* det. by E. F. Guba.

268. Polyporus hirsutus (Wulf.) Fr. On dead branches of *Myrica carolinensis* Mill. Hummock Rd., May 30, 1936. Coll. by *E. F. Guba;* det. by W. W. Diehl.

269. *Pluteus cervinus (Schaeff.) Fr.

270. *Psathyra fibrillosa (Pers.) Fr.

271. *Psilocybe elongata (Pers.) Fr.

272. Puccinia bolleyana Saccardo O., I. On *Sambucus canadensis* L. June 24, 1940. Coll. and det. by *M. A. Rice.*

273. Puccinia caricis (Schum.) Schroet. I. On leaves of *Ribes oxyacanthoides* L. Tuckernuck Island, Aug. 14, 1940. Coll. and det. by *M. A. Rice.*

274. Puccinia convolvuli (Pers.) Cast. II, III. On *Convolvulus arvensis* L. Lily Pond Swamp, Aug. 1940. Coll. and det. by *M. A. Rice.*

275. Puccinia coronata Cda. II, III. On leaves and stems of *Avena sativa* L. See No. 173. Polpis Rd. and in field along Hummock Pond Rd. Aug. 1939. Coll. and det. by *M. A. Rice.*

276. Puccinia coronata Cda. II, III. On leaves of *Holcus lanatus* L. Sept. 1936. Coll. and det. by *E. F. Guba.*

277. Puccinia obtegens Tul. O, II, III. On *Cirsium arvense* (L.) Scop. Lily St., June 19, 1940. Coll. and det. by *M. A. Rice.*

278. Puccinia peridermispora (Ellis. & Tr.) Arth. II, III, with *Phyllachora graminis* (P. ex Fr.) Fckl. On *Spartina alterniflora* Loisel. var. *glabra* (Muhl.) Fern. Edge of Long Pond, Madaket Rd., Aug. 1936. Coll. and det. by *E. F. Guba.* Long Pond, shore near ocean, Aug. 1940. Coll. by *M. A. Rice;* det. by E. F. Guba.

279. Puccinia proserpinacae (B. & C.) Farl. II, III. On *Proserpinaca palustris* L. Tuckernuck. Aug. 14, 1940. Coll. and det. by *M. A. Rice.*

280. Puccinia violae (Schum.) D. C. II, III. On *Viola blanda* Willd. Long Pond Shore, 1940. Coll. and det. by *M. A. Rice.*

281. Ramularia lanceolata Dearn. & House. On living leaves of *Plantago lanceolata* L. Along roadside, Siasconset, Aug. 17, 1936. Coll. and det. by *E. F. Guba.*

282. *Russula aeruginea Lindblad.

283. *Russula mairei Singer = *R. fragilis* (Pers.) Fr.

284. *Russula parazurea J. Schäffer.

285. Russula delica Fr. A very common large funnel-shaped mushroom which pushes up under the mat of pine needles. State Pines south of Fair Grounds, July 29, 1938. Coll. by *E. V. Seeler, Jr.*, det. by J. E. Lange.

286. Russula foetans Pers. Hidden Forest, July 31, 1938. Coll. and det. by *E. V. Seeler, Jr.*

287. Scleroderma lycoperdoides Schw. On ground in garden, 20 Orange St., July 28, 1938. Coll. and det. by *E. V. Seeler, Jr.*

288. Selenophomopsis juncea (Mont.) Petrak. On stems of *Cytisus scoparius* Link. Madaket Rd., May 30, 1937. Coll. by *E. F. Guba;* det. by E. K. Cash. Not previously reported from the United States.

289. Sepedonium chrysospermum (Bull.) Link ex Fr. Parasitic on *Strobilomyces strobilaceus* (Scop.) Berk. State Pines, south of Fair Grounds, Aug. 10, 1940. Coll. and det. by *E. V. Seeler, Jr.* This forms a powdery mass of golden yellow spores on decaying Boleti.

290. Stereum ochraceo-flavum Schw. On stems of *Myrica carolinensis* Mill. killed by fire, Madaket Rd., east of Long Pond, Aug. 30, 1937. Coll. and det. by *E. V. Seeler, Jr.*

291. Synchytrium aureum Schröter. On *Hydrocotyle umbellata* L. 1940. Coll. by *M. A. Rice;* det. by D. H. Linder.

292. Trametes suaveolens (L.) Fr. On *Salix* sp. Hidden Forest, May 30, 1936. Coll. and det. by *I. H. Crowell.*

293. Tramella lutescens Pers. On dead branch of *Acer rubrum* L. Hidden Forest, July 27, 1940. Coll. by *D. H. Linder;* det. by E. V. Seeler, Jr.

294. Tricholoma nudum (Bull. ex. Fr.) Fr. Hidden Forest, October 11, 1940. Coll. and det. by *E. V. Seeler, Jr.* A very beautiful all violet mushroom.

295. Uromyces acuminatus Arth. II, III, with *Claviceps purpurea* (Fr.) Tul. On leaves and stems of *Spartina alterniflora* Loisel. var. *pilosa* (Merr.) Fern. Oct. 1, 1936. Coll. and det. by *E. F. Guba.*

296. Uromyces **ari-triphylli** (Schw.) Seeler, n. comb. *Aecidium caladii* Schw. Schr. Nat. Ges. Leipsig **1:** 69. 1822. *Puccinia ari-triphylli* Schw. Trans. Amer. Phil. Soc. II. **4:** 297. 1834. *Uromyces caladii* (Schw.) Farl. in Arthur p. 214. The specific epithet *caladii* is invalid because it was not based on the teleutospore stage. Internat. Rules Bot. Nomen. 3 ed. Art. 57. For further synonymy see works of Farlow, Arthur and Sydow. On *Arisaema triphyllum* (L.) Schott. Abnecount's Island, Nantucket, July 6, 1940. Coll. and det. by *M. A. Rice.*

297. Uromyces fabae (Pers.) de Bary. II, III. On *Vicia sativa* L. Siasconset roadside, July 26, 1940. Coll. and det. by *M. A. Rice.*

298. Uromyces houstoniatus (Schw.) Sheldon. III. On *Sisyrinchium atlanticum* Bicknell. Quidnet, Aug. 7, 1939. Coll. and det. by *M. A. Rice.*

299. Uromyces houstoniatus (Schw.) Sheldon. O, I. On *Houstonia caerulea* L. Coleman's Bird Sanctuary, June 27, 1940. Coll. and det. by *M. A. Rice.*

300. Uromyces hyperici (Spreng.) Curt. O, I, II. On *Hypericum adpressum* Bart. Along border of pond. Aug. 1939. Coll. and det. by *M. A. Rice.* See No. 97.

301. Uromyces hyperici (Spreng.) Curt. O, I, II. On *Hypericum virginicum* L. Coll. and det. by *E. F. Guba.* Also Tuckernuck Island, Aug. 14, 1940. Coll. and det. by *M. A. Rice.*

302. Venturia inaequalis (Cke.) Aderh. On leaves and fruits of *Pyrus malus* L. Ash Street, Aug. 1940. Coll. and det. by *E. F. Guba.*

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DEPARTMENT OF BOTANY, MASSACHUSETTS STATE COLLEGE
FARLOW HERBARIUM OF CRYPTOGAMIC BOTANY,
HARVARD UNIVERSITY

CONTRIBUTION FROM THE LABORATORIES OF CRYPTOGAMIC BOTANY AND THE FARLOW HERBARIUM, HARVARD UNIVERSITY.—NO. 196

NOTES ON NEW ENGLAND ALGAE

II. SOME INTERESTING NEW HAMPSHIRE ALGAE

ROY M. WHELDEN

That the many and varied bodies of fresh water of New Hampshire should yield rich collections of algae may be anticipated from the frequency with which early American algologists described such plants. Often however the abundance of species and forms encountered in a single pond far surpasses one's expectations, especially when the examination is exhaustively thorough. Among ponds yielding rich returns, Downing Pond in the town of New Durham offers much of particular interest to a student of the algae. Formed at least in part by the damming of a river, raising the water level several feet, this pond covers an area of perhaps 200 acres, over the greater part of which the depth of water is not more than 10 feet. The sandy bottom of the shallower portions, overlaid with a thin layer of fine ooze, is covered with an abundance of *Potamogeton*, *Vallisneria*, *Brasenia*, *Castalia* and other plants, among which occurs an abundance of *Utricularia*. In the deeper portions there are many specimens of *Nitella flexilis* growing on a coarse gravel bottom.

Throughout the summer months all this submerged vegetation, as well as such twigs and logs as occur, are commonly thickly covered with an ooze of algae. The water itself is rich in plankton material, which is not considered in this paper. Many of the algae persist undiminished in numbers until late in the fall and even the coldest weather of the winter does not cause all of them to disappear.

While extensive observations have been made throughout several years, the observations herein reported are based on material gathered and examined in August, then preserved by formalin and studied exhaustively as opportunity offered. They comprise considerations of several algae which differ notably from previously known material from this region or whose occurrence has been rarely cited.

The Genus Staurastrum

Desmids were very well represented in all collections made from this pond, the various genera being proportionately equally well represented. About 30 species of Staurastrum were found in large numbers, most of them being species of larger than average size for the genus. Among these, one of the most frequently encountered in all material was *Staurastrum Arctiscon* (Ehrenb.) Lund., and occurring even more abundantly than the species was the variety *truncatum* Irénée-Marie. (Fig. 4.) In the hundreds of specimens examined some slight variations were noted: by far the greater number of them were noticeably larger than those described by Irénée, the length (processes excluded) ranging from 90–122 μ (processes included, from 155–196 μ); the breadth (processes excluded) was 60–75 μ (processes included, the breadth was 133–162 μ); the breadth of the isthmus 30–42 μ. The other most noticeable variation was found in the nature of the ends of the bifurcated processes. Irénée characterizes the variety in part by the lack of spines ("pointes") at the ends of the processes. In the New Hampshire material this is equally characteristic of a great many of the specimens, but not all. Many have three well-developed acute spines 2–3 μ long at the apex of each arm of the process. The relative dimensions of the cell body and the length and amount of divergence of the processes also show considerable variation.

This variety is not infrequently encountered in other parts of New Hampshire, as well as in western Maine, but in no other station have I found it so plentiful as in the present one.

Staurastrum longispinum (Bail.) Arch. was another species found in some abundance. Among the specimens were some which differed from the type in having three equally large spines (30 μ long) in a vertical row at one, two or all three angles of a semicell. No specimens were observed in which all the angles of the cell were so armed.

THE GENUS MICRASTERIAS

The genus Micrasterias is conspicuously present in nearly all collections from this pond, with *M. foliacea* Bailey the most abundant in numbers, and in filaments often nearly a millimeter long, but rather fragile and easily broken. Fifteen species have appeared in the various gatherings, most of them rather abundantly. Among the rarer ones is *M. Johnsonii* W. & G. S. West.

In 1897 the Wests described this species of *Micrasterias* from Florida. It is characterized by very deep incisions, by the occurrence of two very long spines terminating each division of the lateral lobes, by having one long straight spine from each angle of the polar lobes and by the presence of a row of very fine spines within the margins of the several lobes. The dimensions of the species were given as 270 μ long, 275 μ broad, with the apical lobe 26 μ and an isthmus 30 μ broad.

Taylor (1935) described a variety *bipapillata* from Newfoundland. This variety has shorter spines terminating the lateral lobes, is quite devoid of intramarginal spines and has two mammilate-subaculeate projections on each side of the apical margin of the polar lobe. The variety is somewhat smaller than the species, the length being 250 μ and breadth 240 μ.

Salisbury (1936) described from Florida, as *Micrasterias ranoides*, an alga quite similar to the species, but lacking intramarginal spines and having the polar lobe about one half the width of the cell. The dimensions were: length 208–269 μ; breadth 202–254 μ; thickness 45–50 μ, apex 102–108 μ and isthmus 21–23 μ broad. Krieger (1939) reduced this to variety *ranoides* of *M. Johnsonii.*

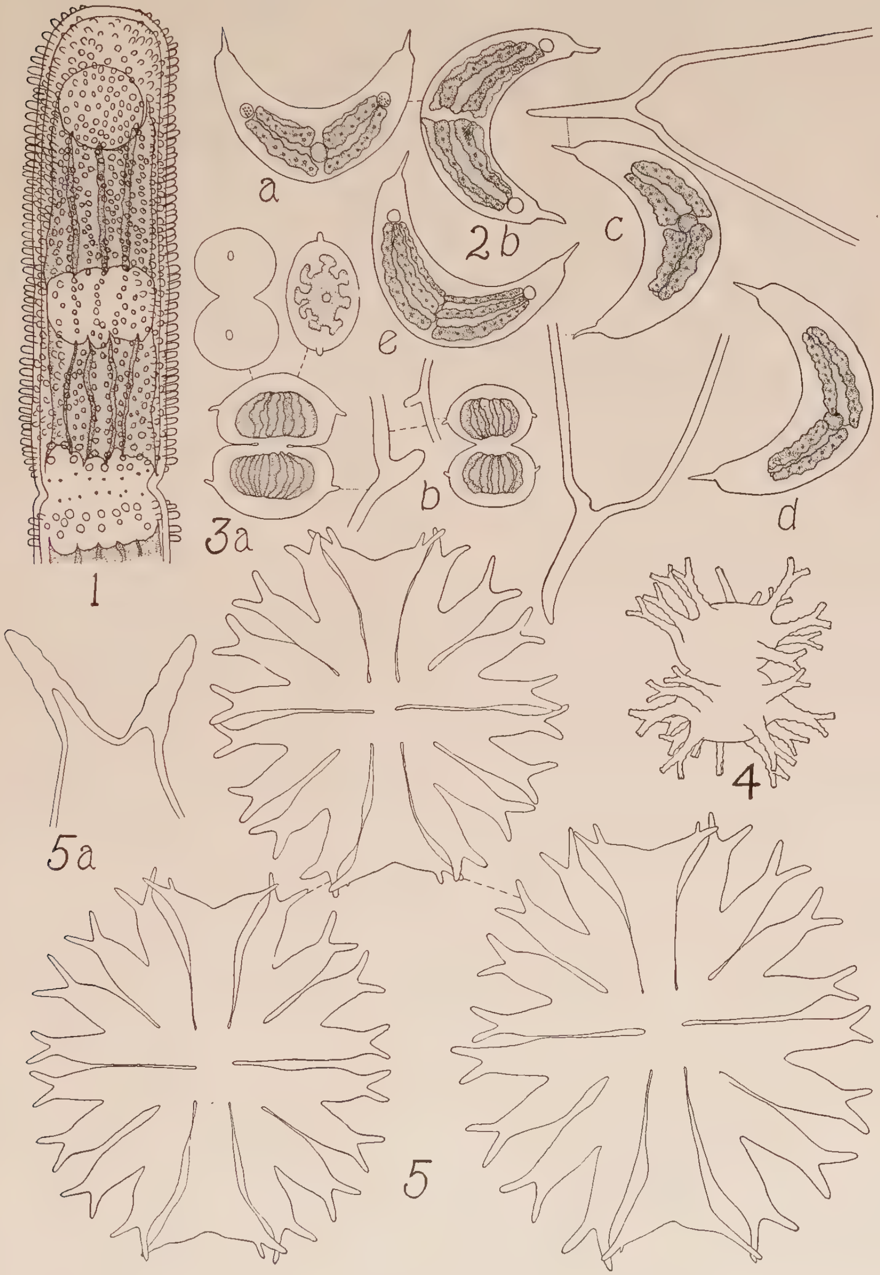
To these there must now be added another variety which has much in common with the two above. Like them the surface of the cell lacks completely any ornamentation of intramarginal spines. Unlike them, each lateral lobe ends in two fairly stout and usually rather blunt spines that are 17–25 μ long and strongly diverging. The polar lobe is broadly obcuneate, widening rapidly in its distal third to a breadth of 90–115 μ. The apical margin of this lobe is usually quite deeply indented in the middle. The exterior angle of the polar lobe ends in a long coarse spine; near this, on the apical margin there is a second spine which may be equal in size to that of the regular spine, but is often much smaller and may be completely missing in one or both the angles of one or both polar lobes. In some specimens the surface of the spines and even of the adjacent part of the lobe is gently and irregularly undulate. (FIG. 5a).

In size this variety varies somewhat, but is generally somewhat larger than any of the previously named forms. I describe this as:

MICRASTERIAS JOHNSONII, var. **novae-angliae,** var. nov. FIG. 5. Differt a typo membrana sine spinis, et apicibus lob. polaris spinis uno vel duobus acutis armatis. Cellulis 280–348 μ long., 270–323 μ lat.; isthmo 19–30 μ lat., lob. polaribus 93–116 μ lat.

THE GENUS COSMARIUM

Considering the large number of described species of *Cosmarium,* the genus appears to be very poorly represented in this pond, only two dozen species having so far been found in any quantity. Of these, *C. ovale* Ralfs, C. *Eloiseanum* Wolle, C. *Quinarium* Lund. & C. *margaritatum* (Lund.) Roy and Biss. are most frequent. Equally abundant and rather more interesting are the frequently encountered specimens of *Cosmarium contractum* var. *papillatum* W. & G. S. West. In the New Hampshire specimens however the cells, while very variable in size, have all much larger dimensions than given by others, having cell length 90–123 μ, cell breadth (without papillae) 62–96 μ; cell thickness 48–55 μ; breadth of isthmus, 19.5–26 μ; length of papillae 2–8 μ. Cell dimensions given by others are: length 73 μ; breadth 51 μ; thickness 44 μ, breadth of isthmus 20 μ, length of papillae 2–3 μ. (FIG. 3, a & b).


1
a
2b
c
d
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3a
b
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5a
5

The Genus Spinoclosterium

Spinoclosterium curvatum Bernard. [*Closterioides spinosus Prescott.*]

In 1909 Charles Bernard described an alga collected in large ponds in the botanic garden at Singapore. He placed it in the new genus *Spinoclosterium,* close to *Closterium,* but readily distinguished from the latter by the presence of a single large spine terminating each apex of the cell. In all other details the plant is like *Closterium,* having a smooth wall, distinct large vacuoles containing several granules each, and a single large chloroplastid in each semi-cell. The plastid seemed to have six radiating bands, with many pyrenoids apparently serially distributed in the bands. His species, designated *curvatum,* measured 120–144 μ between apices, 150–170 μ along the concave, and 240–275 μ along the convex side. It was 47–52 μ broad, with apical spines 15–24 μ long and 5–7 μ broad at base. The spines were quite noticeably curved.

In 1937 Prescott, presumably unaware of Bernard's paper, recorded as *Closterioides spinosus* certain Closterium-like algae from Michigan. His species was distinguished by a smooth colorless cell wall, cells slightly attenuated to broadly rounded poles, each of which bears a single stout spine. There are two plastids per cell, each with 2–3 longitudinal regions showing pyrenoids in 3 or 4 irregular series; the cells measured 140–148 μ between apices, were 58–62 μ broad, and had spines 4.5 11.5 μ long. Subsequently Prescott, (1940) having seen living cells, considered them sufficiently distinct to warrant separation from *Closterium,* and very close to Bernard's *Spinoclosterium curvatum.* Since his plants are slightly stouter, bear stouter and longer spines, and have a distinct swelling of the apices, he separates them as *Spinoclosterium curvatum* var. *spinosum.* It is quite probable that this alga is not quite so rare as the infrequency with which it has been observed would suggest. I have seen many specimens collected from a marshy pond in Maine. There many of them were infected with a small fungus which had completely destroyed all normal cell content: those which escaped infection were so densely packed with food reserves as to obscure quite thoroughly the plastid structure. In the New Hampshire collections on which this report is based *Spinoclosterium* cells are not truly rare. However it is evident that they occur either singly or at most in small groups of two or three individuals and so may be easily overlooked unless systematic search is made. Then they turn up frequently.

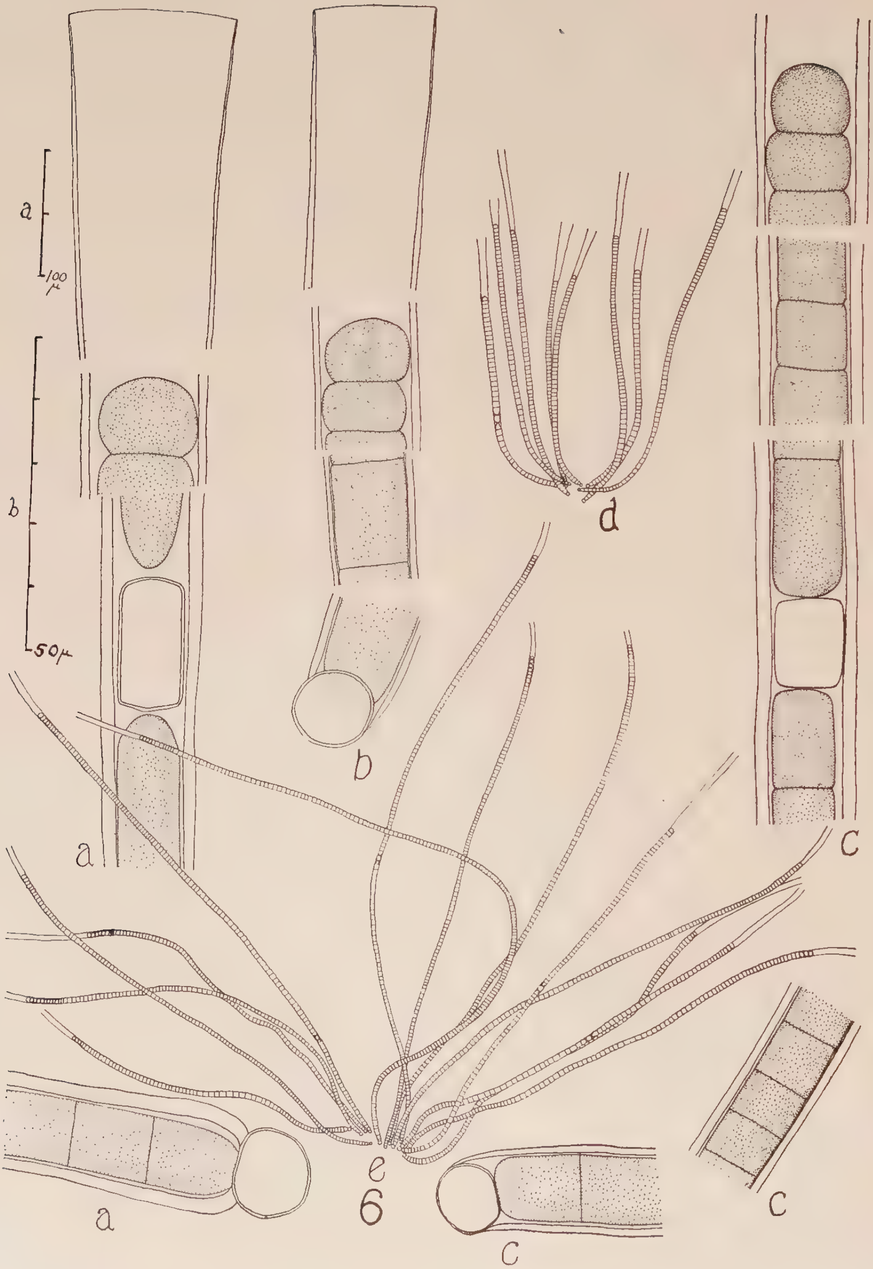
All those seen have been very strongly curved, the outer margin much more so than the inner. Tapering is very gradual from the center of the cell to a point a few microns from the apex, at which point a very abrupt narrowing occurs, culminating at the base of the spine. In some specimens there is a slight bulging of the outer margin of the cell just before this contraction point, causing the cell to appear distinctly swollen at this point (Fig. 2a). This swelling may appear only at one end of a cell, or at both, and is frequently entirely lacking. The strong spine which terminates the cell end is usually quite straight (Figs. 2a, d, e) although specimens having one (Fig. 2c) or both spines (Fig. 2b) quite distinctly curved outward are not rare.

The chloroplastids are composed of five longitudinal plates each having a row of 6–10 pyrenoids. A large vacuole is present at each end of the cell, but in only a few of my specimens (all from preserved material) was there any indication of granules within the vacuole. In these there were 10–14 small granules present.

All specimens were quite uniform in size, measuring 144–160 μ between the apices of the spines, 54–61 μ in diameter at the broadest part and having spines 17–20 μ long. Fig. 2.

The Genus Penium

Specimens of the genus *Penium* are not common in this station: *P. spirostriolatum* Barker and *P. margaritaceum* (Ehrenb.) Bréb. are found infrequently, and *P. rufescens* Cleve rarely. One which occurs quite rarely seems best considered a variety of *P. margaritaceum*, characterized by the presence of many papillae over the entire surface of the cell excepting a narrow band at the isthmus, and the central portion of the apical surface. These papillae are 2–3.5 μ long, and arranged either irregularly or less frequently in vaguely delineated longitudinal rows. I designate these plants as:



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PENIUM MARGARITACEUM (Ehrenb.) Bréb. var. **papilliferum,** var. nov. Penium membrana papillifera, papillis irregulariter dispersis vel lineis ordinatis; cell. 150 μ long.; Papillis 2–3.5 μ longit. FIG. 1.

MICROCHAETE VS. LEPTOBASIS

The blue-green algae are found in wide variety in this pond, but usually only in rather small numbers. Periodically exceptions occur, some form becoming extremely abundant for a short time, as occurs during the last two or three weeks of August, or early September, when *Nostoc planctonicum* becomes a dominant and conspicuous plant in the upper 2–3 feet of water.

Among those species which appear to occur regularly but never in any quantity is a species of *Microchaete* which seems worthy of some comment. All specimens that were observed were growing on the submerged stems or leaf sheaths of various phanenogams; the lower part of the filament of the *Microchaete* being usually, but not invariably, close pressed thereto. They are found in small groups composed of 3–16 filaments, the free ends of which may stand erect and nearly parallel, (FIG. 6d) or may spread in a group of widely divergent strands, (FIG. 6e) mostly 300–600 μ long, but infrequently reaching more than 1 mm. Each trichome is surrounded by a firm colorless sheath 1.3–2.0 μ thick in its thickest part. As a rule the sheaths are unstratified, but several groups of filaments were observed in which all or nearly all of the sheaths were composed of two or three very distinct strata which faded out only towards the apex of the filament, where the sheaths became very much thinner. One of the most noticeable characteristics of the sheaths was in their dimensions. The greater number of them showed a very evident increase in diameter from the base upwards: (FIG. 6a) measurements taken at 100 μ intervals of one filament are as follows—11.5, 13, 15, 15, 17, 17, 17, 17.5, 18, 19, 22 μ. Other filaments, often in the same group as those with increasing diameters, are either isodiametric (FIG. 6c), or else may even show a slight decrease as in one case from 16.5 to 15 μ.

The trichomes likewise show considerable variation, both in dimensions and in the nature of the component cells. In the filament whose increasing dimensions are given above the corresponding dimensions of the trichome increase from a basal

9.5 μ to a maximum of 12.5 at the apex of the trichome, which ended nearly 300 μ below the end of the sheath. The dimensions of the trichome in the other sheath mentioned above decreased from 12.5 to 11.5 μ. The smallest trichome diameter measured was 7 μ, in a sheath 11 μ in diameter: this same filament was 15 μ broad at the apex, with the trichome 11.5 μ at its apex. The shape of the cells composing the trichomes varied from base to apex. The cells of the basal portion were rectangular in optical section and varied in length from 0.6–1.6 times as long as broad: in this portion of the plant there was none or only a very slight constriction of the trichome at the dissepiments. These relative dimensions might obtain nearly throughout the trichome, but in many cases the cells of the central portion were conspicuously longer, being up to 2 times as long as broad, and seldom less than 1.2 times as long: here constrictions were rarely evident. Near the apex of the trichome the cells were much shorter, 0.6–0.9 times as long as broad, and so obviously constricted that they occasionally appeared like beads (Figs. 6a, b, c). The cell contents are usually very uniformly homogeneous. In many cases however the apical cells of the filament were prominently vesiculate (Fig. 6b). In a few instances, filaments were seen in which the cells contained many small vacuoles, possibly a consequence of the condition of those cells at the time of preservation.

Heterocysts were both basal and intercalary. The basal heterocysts were mostly subspherical and 9.5 to 12.5 μ in diameter (Fig. 6a, b, c); a few were somewhat flattened, being 11–13 μ broad and 7.5–9 μ long. Intercalary heterocysts were cylindrical and 9–21 μ long (Fig. 6, a, c). No other types of cells were observed, nor was any sign of branching noted.

The identification of this plant offered certain problems. *Microchaete* comprises those algae in which a single trichome, rarely branched, is included in a distinct sheath usually homogeneous but in a few species distinctly stratified, the sheath either of uniform diameter throughout or slightly narrowed towards the apex. The filaments grow attached to various substrates, either singly or in small groups. Basal and less frequently intercalary heterocysts occur, as well as akinetes. With the genera *Aulosira* and *Hormothamnion*, *Microchaete* makes up the family Microchaetaceae.

Elenkin (1915) described the genus *Leptobasis*, the only genus in the family Leptobasaceae, characterized principally by the distinct widening of the filament towards the apex. There is also usually a distinct narrowing of the filament in the basal portion, but the greater part of the filament is of uniform diameter. Basal and rarely intercalary heterocysts occur. The separation of this family from the Microchaetaceae seems often to be a matter of some doubt. In *Leptobasis* there is one species *L. crassa* (G. S. West) Geitler, originally described by G. S. West as *Microchaete crassa.* This plant, occurring at 2600 m. in the Eastern Andes mountains, had filaments 13–16 μ broad, slightly narrowed at the base and not widened upwards, colorless unstratified sheaths, and grew in small groups of slightly bent filaments. The basal cells of the trichome were rather longer than broad, 9–10.5 μ in diameter, whereas those near the apex were 12–13 μ in diameter and rather shorter than broad. There were no constrictions at the cross walls. The spherical heterocysts were mostly basal and 9–10.5 μ in diameter. Certainly there was little which justified removing the species from *Microchaete* to a position in *Leptobasis*. Two species of *Microchaete* need now be considered. These are *M. uberrima* N. Carter, found in rice fields of India, and *M. calothrichoides* Hansgirg, in standing water in Prater in Vienna. Miss Carter's species is characterized by its filaments of uniform diameter 16–18 μ throughout, with firm brown sheath around a trichome 10–14 μ in diameter. She also describes a form *minor* with filaments 9–11 μ broad and trichomes 6.5–8 μ. This at once suggests that there may be considerable variation in size in species of this genus. *M. calothrichoides* has filaments 10–16 μ (–20 μ) broad, occurring singly or in small groups, the latter forming a dull gray-green layer of straight or bent strands. The sheaths are thick, stratified, often more or less encrusted, and colorless. Cells at the base of the filament are 6–8 μ broad and ⅓–1 times as long, with distinct constrictions at the cross-walls. The basal heterocysts are egg-shaped to elongate—ellipsoidal, 6–8 μ broad.

No other of the described species seems to approach in character the New Hampshire plant. In size it could well be placed in either species, though it tends to be distinctly larger than *M. calothrichoides:* the shape of the cells and the size and shape of the basal heterocysts equally serve to distinguish it from this species. The most conspicuous distinction between it and *Leptobasis crassa* is found in the distinctly constricted filaments of the former. The slightly larger average dimensions of the filament and equally slightly smaller dimensions of the trichome are not sufficient to set it off. It therefore seems justifiable to identify it as *Microchaete crassa* G. S. West (= *Leptobasis crassa* (G. S. West) Geitler), while noting specifically the fact that there is a distinct increase in the diameter from base to apex in the majority of the filaments. The great variability in the form of the filaments in this species throws doubt on the basis on which *Leptobasis* is established; it is better to place its species in the genus *Microchaete*, where they may be distinguished as a subgenus. Following DeToni (Noterelle di nomenclatura algologica VIII. Terzo elenco di Missoficee omonime. 1936) this alga should be *Fremyella crassa* (G. S. West) DeToni.

DESCRIPTION OF FIGURES

FIG. 1 and details of FIGS. 2, 3, 5 and 6 are all drawn to scale b; All others are drawn to scale a.

1. PENIUM MARGARITACEUM (Ehrenb.) Bréb. var. PAPILLIFERUM, var. nov.
2. SPINOCLOSTERIUM CURVATUM Bernard. *A*, *d* and *e* are specimens with straight spines; *b*, with both spines curved; *c*, with one curved and one straight spine.
3. COSMARIUM CONTRACTUM var. PAPILLATUM W. & G. S. West. *a* is a large form, *b* a small one.
4. STAURASTRUM ARCTISCON var. TRUNCATUM Irénée-Marie.
5. MICRASTERIAS JOHNSONII W. & G. S. West var. NOVAE-ANGLIAE, var. nov., showing variations in size and in nature of spines of apical lobe. (*5a*) Portion of apex of lateral lobe.
6. MICROCHAETE CRASSA G. S. West. Habit. *a.* Portions of a filament showing considerable increase in size base to apex. *b.* Portions of a filament showing slight increase, and with cells showing vesiculate cytoplasm. *c.* Portions of filament in which diameter is nearly uniform. *d.* A small group of nearly erect filaments. *e.* A larger group of filaments, widely diverging.

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POLLINATION OF THE ERICACEAE: VI. VACCINIUM CAESPITOSUM ON MT. KATAHDIN[1]

Harvey B. Lovell

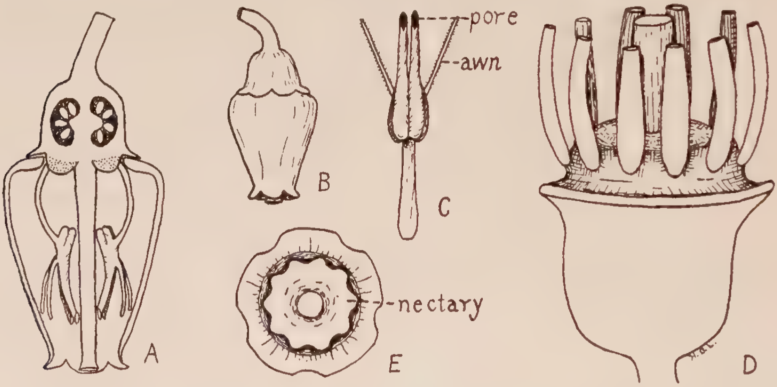
The long awns and slender anther-tubes together with the method of nectar secretion make *Vaccinium caespitosum* Michx. one of the most specialized flowers in the Heath Family. Although the related species, *V. uliginosum*, has been studied in Europe, there do not appear to be any published observations on the anthesis and insect visitors of the present species. *V. caespitosum* grows abundantly on the higher slopes of Mt. Katahdin above the tree line, where in spite of the inclement weather it sets fruit abundantly. Each leafy shoot produces a single nodding flower at the first node and the remaining leaves of the shoot almost completely conceal the flower from above. On steep slopes the side of the corolla exposed to the light is pink, whereas that next to the hillside remains white.

The five-merous flowers have a slender corolla-tube 5 to 5.5 mm. long which tapers down to 1.5 mm. in diameter at the apex. Since the stigma partially closes this opening, the nectar is rendered inaccessible to all but long-tongued insects. The corolla is very firm and tough. The capitate stigma, which stands just inside of the mouth of the flower, is very glutinous and pollen clings to it readily. Around the base of the style there is a thick, green ring, evidently the nectary, although in most cases little nectar was found on it (fig. 1, A, E), a lack which will be discussed later. Inserted on the margin of the nectary and base of the corolla are the ten stamens. In many flowers the corolla fell off leaving the stamens still attached to the

[1] Contribution from the Biology Department, University of Louisville.

nectary (fig. 1, D). Each stamen consists of a slender hairless filament and an anther which terminates in a pair of long slender tubes (fig. 1, C). Each tube opens by an oblique pore which rests against the style in such a way that the pollen is retained until the tube is displaced. From the back of each anther a pair of long slender awns extend nearly to the corolla-tube. The surfaces of the awns are minutely roughened.

A great deal of nectar was found between the filaments and the base of the corolla. Some of the flowers were a third full of the liquid which was clearly visible through the translucent corolla. The nectar is secreted by the margin of the nectary and escapes between the bases of the filaments, a condition similar to that found in *V. Myrtillus* L. of Europe and in *V. uliginosum*. This position of the nectar is correlated with the hairless filaments and the presence of awns. In *V. Vitis-idaea*, var. *minor*, a species which lacks awns, the nectar is retained in the center of the flower by a circle of hairy filaments. The habits of the insect visitors are different in the two species. In the latter they probe between the anther tubes and the style and so release the pollen by pushing the pores away from the style. In *V. caespitosum* the awns play an important role in pollination. While sucking up nectar lying outside the filaments in an awnless flower, the tongue of a visitor would rarely displace the anther tubes. The projecting awns, however, furnish an obstruction which cannot be avoided, and when struck by an insect's tongue, are certain to pull aside the pores sufficiently to release the pollen. When



such an insect with its mouth parts dusted with pollen visits another flower, these organs strike the stigma first, and thus the process of cross-pollination is completed.

It is possible that self-pollination may occur by the falling of the pollen upon the glutinous stigma, especially when the flowers are shaken by the high winds of the mountain top.

The base of the corolla is conspicuously thickened and very succulent (FIG. 1, A) suggesting that it too may secrete nectar.

Bumblebees belonging to three species were the only visitors and they are all species common in northern New England at low elevations and not, as had been hoped, Arctic forms. They were observed, however, to work under conditions of high wind and dense fog which would have ordinarily stopped visits. The concealed position of the flowers beneath the leaves made them difficult to approach by flying insects, bumblebees often falling on the ground and being obliged to crawl up to the flowers. When they reached a flower, they seized it roughly with their anterior legs, thrust in their tongue and pivoted around the flower upside down. Many of the flowers had their tips chewed off by the bumblebees, a mutilation which probably did not seriously interfere with pollination. The exceptionally abundant nectar proved ample attraction, and the flowers were visited repeatedly, especially by *Bombus terricola*.

The following insects were collected on Mt. Katahdin, Maine, at altitudes of 4200 to 4600 feet from July 14 to 16, 1937, and on July 27, 1941, all sucking nectar.

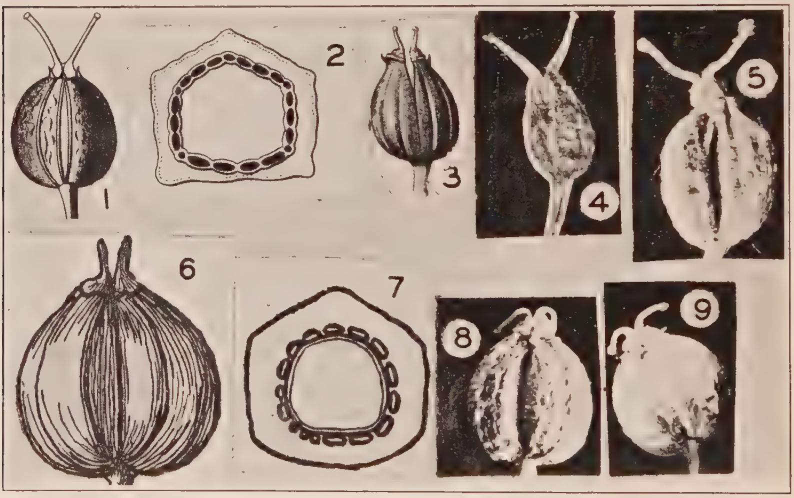
HYMENOPTERA. Apoidea. *Bombus terricola* Kirby 9 ☿; *B. vagans* Sm. 1 ☿; *B. ternarius* Say 3 ☿.

LOUISVILLE, KENTUCKY.

BERULA **pusilla** (Nutt.), comb. nov. *Sium pusillum* Nutt. in Torr. & Gray, Fl. N. Am. i. 611 (1840). *S.* ? *incisum* Torrey in Fremont, Rep. Expl. Rocky Mts. 90 (1845). *S. angustifolium* sensu Am. auth., not L. *B. augustifolia* sensu Am. auth., not Mert. & Koch. *B. erecta* sensu Coville in Contrib. U. S. Nat. Herb. iv. 115 (1893), not *Sium erectum* Hudson, basinym. *S. Novae-Mexicae* Koso-Poljansky in Bull. Soc. Nat. Moscou, n. s. xxvii. 173 (1915).

The North American plant has generally been treated as specifically identical with the Eurasian *Berula erecta* (Huds.)

Coville (*Sium erectum* Huds., *S. angustifolium* L., *B. angustifolia* (L.) Mert. & Koch). Our plant, however, has the calyx-lobes obsolete, the Eurasian plant with them evident; the styles very short and generally recurved, in the Eurasian plant prolonged and ascending; and the mericarps scarcely angled, in the Eurasian 5-angled. As pointed out by H. Wolff in Engler, Pflanzenr. iv^{228}. 339 (1927), the leaflets of the American plant average smaller and more incised, and the umbels smaller than in the Eurasian specimens. The differences in fruit and development of calyx-lobes and styles are shown in FIGS. 1–9, FIGS. 1–5 of Eurasian *B. erecta*, FIGS. 6–9 of *B. pusilla*. FIGS. 1 and 2 are after Reichenbach, Ic. Fl. Germ. xxi. t. mdccclxxviii. figs. 7 and 9; FIG. 3 after Hegi, Ill. Fl. Mittel-Eur. v², t. 198, fig. 3b (1926); FIG. 4, young fruit, × 10, from *Seringe*, Herb. Helv., no. 2384; FIG. 5, fruit, × 10, from Genève, *Reuter*. Of FIGS. 6–9, showing fruits of *B. pusilla*, FIGS. 6 and 7 are after Koso-Poljansky; FIG. 8, mature fruit, × 10, from Guadalupe Mts., Texas, *Havard*, no. 237; FIG. 9, × 10, from Los Angeles, California, July, 1879, *Nevin*.



The many contrasts, including the more lacerate and smaller leaflets of *B. pusilla*, are well brought out by Koso-Poljansky; unfortunately, he did not know of the two earlier and quite available specific names and conferred a very unusual new one. I am indebted to Dr. Wittrock for the loan of Nuttall's type of *Sium pusillum,* preserved at the New York Botanical Garden.— M. L. Fernald.

TWO FERNS NEW TO VIRGINIA

Carroll E. Wood, Jr.

In 1915 Fernald gave the range of *Botrychium lanceolatum* (Gmel.) Ångstroem var. *angustisegmentum* Pease & Moore as extending from the St. John Valley, New Brunswick, to eastern and southern Ontario, Ohio, Pennsylvania, and New Jersey, with the greatest development of the plant from Maine to central New York.[1] More recently, Wherry reported the plant as ranging south to Essex County, N. J., Chester and Lancaster Counties, Pa., and Randolph County, West Virginia.[2] Brooks included in his *Pteridophytes of West Virginia* both the Randolph County locality where a single specimen was found on Cheat Mountain (alt. 4000′) by Mr. Russell West and an additional station discovered by Dr. P. D. Strausbaugh near Green Bank in Pocahontas County.[3] Apparently these last two occurrences are the most southerly heretofore recorded, the fern presumably never having been found before in Virginia.

The discovery of a colony at an altitude of approximately 3800′ near Mountain Lake, Giles County, Virginia, is of interest, therefore, both as a range extension southwest along the Alleghenies (about 75 miles) and as an addition to the flora of Virginia. On August 11, 1941, ten plants were found growing in humus-rich shaly soil (pH 5.9 as determined by the glass electrode method) in cool maple-birch woods in the ravine of Doe Creek about ½ mile southwest of Mountain Lake Post Office. Although individual plants exhibited considerable variation in size (7–17 cm.) all were in fruiting condition. The plants all agree closely with more northern specimens and with the Pocahontas County specimen which Dr. Earl L. Core very kindly sent for comparison from the Herbarium of the University of West Virginia. Nearby were found the other *Botrychium* species of the region (*B. dissectum* Spreng., *B. dissectum* var. *obliquum* (Muhl.) Clute, and *B. virginianum* (L.) Sw.). Unfortunately, the stand of *B. lanceolatum* is threatened by local lumbering operations and washing of the Martinsburg shale which is already encroaching on the small area occupied by the plants. The presence of *Dryopteris Goldiana* (Hook.) A. Gray farther down the ravine should be noted as a new county record.

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[1] Fernald, Rhodora 17: 87 (1915)

[2] Wherry, Guide to Eastern Ferns, p. 25 (1937)

[3] Brooks and Margolin, Pteridophytes of West Virginia, p. 11 (1938)

Cystopteris fragilis (L.) Bernh. var. *genuina* Bernouilli is known chiefly as a circumboreal plant which in eastern North America occurs in Pennsylvania as far south as Somerset and Fayette Counties and then reappears in the high mountains of North Carolina.[1] On August 26, 1941, specimens of *C. fragilis* were collected from a dripping granitic cliff at an altitude of over 5000 feet on the north slope of White Top Mountain just below the spruce "cap" in Washington County, Virginia. Subsequent examination of these specimens by Dr. E. T. Wherry shows them to be the variety *genuina*, previously unknown from Virginia, but to be expected on the high mountains along the North Carolina and Tennessee borders.

Specimens of *B. lanceolatum* var. *angustisegmentum* from Mountain Lake will be placed in the herbaria of the Academy of Natural Sciences of Philadelphia, University of Pennsylvania, Virginia Polytechnic Institute, and Mountain Lake Biological Station as *Wood no. 1377*. The *C. fragilis* from White Top Mountain is in the herbarium of the University of Pennsylvania as *Wood no. 1391*.

University of Pennsylvania

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[1] Wherry, Guide to Eastern Ferns, p. 75 (1937)

Volume 44, no. 520, including pages 93–152, a portrait and plates 696–707, was issued 10 April, 1942.

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